CONCRETE AND SOIL ASSESSMENT

UMore Park
Rosemount, Minnesota

Prepared for:

University of Minnesota
Real Estate Office

October 13, 2006

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UMORE PARK
ROSEMOUNT, MINNESOTA

(Peer File #16069.01)

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October 13, 2006

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1.0 INTRODUCTION

Peer Engineering, Inc. (**Peer**) has been retained by the University of Minnesota (**University**) to conduct a Concrete and Soil Assessment (the **Assessment**) of a portion of the University's Outreach, Research, and Education (**UMore**) Park property located in Rosemount, Dakota County, Minnesota (the **Property**). The Property was formerly developed as the Gopher Ordnance Works (**GOW**) in the early 1940s.

The objectives of this Assessment were to 1) quantify by volume, and assess remnant concrete GOW building foundations and walls, 2) determine possible alternatives for reuse, reconditioning and/or disposal of the concrete, and 3) evaluate the environmental condition of soils adjacent to and/or in contact with the remnant concrete foundations.

2.0 BACKGROUND

2.1 PROPERTY DESCRIPTION AND HISTORY

The Property is approximately 5,000 acres in size and consists of fifteen contiguous parcels that are located south of 145th Street, west of Highway 52, north of 170th Street, and east of Biscayne Avenue in Rosemount, Dakota County, Minnesota (see **Figure 1**). The Public Land Survey coordinates for the Property generally include all or parts of T114N, R19W, Sections 1-4 and T115N, R19W, Sections 25-28 and Sections 33-36. The Property is part of the larger UMore Park, which is owned by the University. **Figure 2** presents a diagram depicting the entire UMore Park property. The Property is the section of UMore Park that is depicted in yellow in **Figure 2**. The portion of UMore Park south of 170th Street is excluded from this project.

The Property is part of a larger tract of land approximately 11,700 acres in size, which consisted of former homesteads and agricultural land that were acquired through condemnation by the federal government during World War II for construction of the GOW. The GOW consisted of approximately 858 buildings and associated utilities and infrastructure designed for the production of smokeless gunpowder and related by-products. The GOW operated primarily on the northern and eastern portions of UMore Park. Two parallel powder production facilities were planned. The first facility (**"A", "B", "C" line**) was completed on the northeastern portion of the Property and manufactured nitrocellulose (**smokeless gunpowder**) and gunpowder manufacturing related by-products for approximately eleven months during late 1944 and 1945. The facility included an **oleum** plant (**sulphuric** or **sulfuric acid**) and nitric acid (**ammonia oxidation**) plant. The second facility (**"D", "E", "F" line**) was located on the west-central portion of the GOW site and, though partially completed, reportedly never became operational. The GOW halted production in September 1945. In 1947 and 1948, the University acquired approximately 8,000 acres of the former GOW from the federal

government. The remaining approximately 4,700 acres of the GOW was sold back by the Federal Government to farmers and other parties. With subsequent land sales, UMore Park now comprises approximately 7,500 acres.

UMore Park presently consists of two primary operating units: the Rosemount Research and Outreach Center (**RROC**) and the University of Minnesota Rosemount Research Center (**UMRRC** or **RRC**). The RROC is a branch of the Minnesota Agricultural Experiment Station. RROC conducts research in agricultural and animal science, veterinary medicine, environmental sciences, and building construction methods. The RROC comprises approximately 3,500 acres of the Property located south of County Road 42, west of Akron Avenue, north of 170th Street and east of Biscayne Avenue. The RRC is under the direction of the University's Real Estate Office and manages internal and external partnerships, leases, and the physical plant of UMore Park, including a number of remnant structures from the GOW. The RRC comprises approximately 4,000 acres of the Property south of County Road 42, north of 170th Street and east of Akron Avenue. The Property was formally named UMore Park in 2003.

2.2 PREVIOUS INVESTIGATIONS

Peer recently completed a Phase I Environmental Site Assessment (**ESA**) of the Property on behalf of the University. The results of the Phase I ESA are presented in the following document:

- Phase I Environmental Site Assessment, UMore Park, Rosemount, Minnesota, dated July 26, 2006 (the **Phase I ESA**).

The Phase I ESA summarizes the historical GOW operations and post-GOW land use activities at the Property, and describes previous environmental investigations. The most recent environmental investigation was conducted by the University and the Minnesota Pollution Control Agency (**MPCA**) in cooperation with Dakota County in 2002/2003 to evaluate potential impacts from former GOW operations (the **2003 Environmental Investigation**). The findings of the 2003 Environmental Investigation are presented in the following report prepared by Peer:

- Preliminary Environmental Investigation, Former Gopher Ordnance Works, U/More Park, Rosemount, Minnesota, dated August 19, 2003.

In 2002, Peer completed a historical review of readily available information regarding the GOW. Based on the review, Peer identified a number of former GOW operation areas with potential for environmental impacts. Dakota County staff also completed detailed information review, as well as site visits and historical aerial photograph review. Information from the aerial photograph review was mapped using Geographic Information System (**GIS**) methods to allow for easy identification of locations in the field. Based on the results of the information review and subsequent discussions between the MPCA, the University and Dakota County, six areas (five of which were located on the Property and one which was located just south-southeast of the Property) were the subject of a limited subsurface investigation in late 2002/early 2003. The areas investigated on the Property included the Oleum Plant, the Nitric Acid Plant, the Burning Grounds, the Waste Water Treatment Plant and Power Plant "A" area, and Main Shops area (see **Appendix A**).

- Concrete and Soil Assessment Work Plan, Umore Park, Rosemount, Minnesota, dated August 31, 2006 (the **Assessment Work Plan**).

Peer prepared the Assessment Work Plan for the Assessment prior to the start of field activities and submitted it to the MPCA Voluntary Investigation & Cleanup (VIC) Program for review and approval. The Assessment Work Plan describes the historical background information regarding the GOW operational areas, and presents proposed methods and procedures for the field activities. The MPCA VIC Program approved the Assessment Work Plan in an email to Peer dated September 5, 2006.

2.3 GOW OPERATIONAL AREAS AND ASSOCIATED FACILITIES

Based on historical research conducted as part of the 2003 Environmental Investigation and the recently completed Phase I ESA, various former GOW operational areas and associated facilities have been delineated at the Property. **Appendix A** includes two index maps including a **GOW Operational Areas Map** of the entire Property, and an **East Operational Areas Map** of the eastern half of the Property. Both index maps were prepared by Dakota County and are based on a 1945 aerial photograph of the Property obtained from Markhurd™. The maps include an overlay of a geo-referenced 400 foot by 400 foot grid system of the Property, which was developed by Dakota County. The Property-wide grid system allows for efficient determination of Property features and building remnant locations using a field Global Positioning System (**GPS**) unit.

This Assessment focused on Select Remnants located on the eastern half of the Property, which were selected by the University and were representative of GOW facilities, operational areas and other remnants located on the northeastern and west-central portions at the Property. Seven key GOW operational areas (the **Operational Areas**) at the Property were evaluated as part of this Assessment including:

Operational Area	Approximate Grid Coordinates
East Acid Area and Oleum Plant	E41-E45 x N25-26
East Guncotton/Nitrocellulose Production Area (A, B, C Lines)	E36-E38 and E39 x N23-N26
East Solvent Area	E33/E34-E40 x N16-N20-½
East Powder Manufacturing Area	E35-E40 x N4-N17 and E32-E34 x N8-N10
East Powder Testing Area	E42-E43 x N16-N17 and E34-E39 x N3
Power Plant "A" Area	East ½ of E41, E42 and E43 x N19-N23
Main Shop Area	N24-N27 x E31-E34

Information regarding these Operational Areas is provided in the Phase I ESA report and Assessment Work Plan, including operational processes that occurred in the area, potential contaminants, and known impacts (if the area has been previously investigated). Fifty-one (**51**) building remnants/structures (the **Selected Remnants**) as identified in **Table 1** were targeted for concrete and soil sampling activities. **Table 1** lists the building number, building name, X-Y coordinates and estimated concrete surface area for each of the Selected Remnants which were evaluated during this Assessment. The listed X-Y coordinates were previously determined by the University and are based on the Universal Transverse Mercator (**UTM**) coordinate system. The locations of the Selected Remnants are shown on the **East Operational Areas Map** in **Appendix A**.

It should be noted that some remnants as described in the Assessment Work Plan were inaccessible or could not be located, and therefore upon consultation with University staff, alternate remnants/structures were substituted as follows:

Remnant Proposed in Work Plan	Alternate Remnant Assessed
302A/Ammonia Oxidation Plant	302-A1/Acid Area Tank Farm NA Storage Tanks
1501-9/Oleum Plant	1501-5/Oleum Plant - Sulfur Storage
102B-4/Nitrocel Area Tank Farm - Acid Tanks	102-B2/Acid Tanks on Saddles
706J/Cotton Drying Laboratory	707F/Purification Change House
227D/Dry Ingredients Storehouse K2SO4	251B/Activated Carbon Solvent Recovery
214B-11/Solvent Recovery House	214C-13/Solvent Recovery House

220B/Controlled Dry Circulation	220C/Controlled Dry Circulation
237B/Tray Dryers and Fan House	237F/Tray Dryers and Fan House; samples labeled as "237K"
238A/Glaze Barrel House	238B/Glaze Barrel House
239B/Shaker Sieve House	239A/Shaker Sieve House
240B/Powder Blend Tower and Pack House	240C/ Powder Blend Tower and Pack House
228C/Ballistics Lab - Powder Magazines	228A/Ballistics Lab and Range
717B/Sand Blast	726-A1/Unspecified Storage

3.0 METHODS AND PROCEDURES

3.1 OVERVIEW

The following sections summarize the field methods and procedures used for this Assessment. Standard operating methods and procedures that were used are included in **Appendix B**. Field activities (concrete volume measurements, concrete sampling, and test trenching/soil sampling) were conducted from September 6, 2006 through September 18, 2006 at the 51 Selected Remnants identified in **Table 1** and shown on the **East Operational Areas Map** in **Appendix A**. Specific concrete sample and test trench/soil sample locations are shown on the individual **Operational Area Maps** included in **Appendices C** through **I**.

Initial Property Reconnaissance

On September 5, 2006 prior to the start of field activities, Peer conducted an Initial Property Reconnaissance with University staff to verify the location of Selected Remnants, and select and mark locations for concrete sampling and test trenching. In addition, as field activities progressed, Peer conducted daily reconnaissance as necessary to verify the concrete sampling and test trench locations. The Selected Remnant locations were identified with the University's assistance using historical GOW as-built building plans and aerial photographs, a field GPS unit with sub-meter accuracy, and the 400 foot by 400 foot Property-wide grid system.

Peer identified concrete sampling locations for each Selected Remnant based on historical GOW building plans and site-specific observations. Sampling locations were chosen to provide representative coverage of the concrete remnant and when warranted individual samples were targeted for areas on the remnant with suspect use (e.g. a former electric room, machine room, etc.) as identified on building plans or suspect visual conditions (e.g. concrete discoloration, staining, suspect asbestos-containing materials such as mastic, and other indicia of potential contamination). Sampling locations were also selected based on accessibility (e.g. locations that included

unobstructed concrete structures, accessible adjacent ground surface areas, or areas that required nominal vegetation removal).

Peer identified test trench and associated soil sample locations based on review of the available historical GOW records regarding the original building construction features (e.g. locations of former process areas, drains, sewers, discharge points or other potential sources for releases of hazardous substances) and on observations made during the Initial Site Reconnaissance (e.g. areas with observed discoloration, staining, odors, and other indicia of potential contamination). In general, the test trench locations were targeted to assess foundation/footing depths and potential discharge points associated with the buildings (e.g. points were sewer and/or process lines enter/exit the structure). The test trench locations were also selected in order to accommodate obstructions (e.g. large trees, overhead or underground utilities, etc.).

Utility Clearance

Prior to the start of the field activities, Peer's excavation subcontractor, Veit Specialty Company (**Veit**) of Rogers, Minnesota, notified the Gopher One-Call System and had public utilities located at the Property. In addition, University personnel assisted in identifying the locations of private utilities at the Property.

Site Safety and Health Plan

Prior to accessing the Property, Peer prepared a Site Safety and Health Plan (**SSHP**). The SSHP described suspected hazards and chemicals that may be encountered, and outlined safety methods and procedures to be employed to protect personnel during completion of this Assessment.

3.2 CONCRETE VOLUME ESTIMATES

The volume of the concrete remnants/structures present on the Property were estimated by Peer as part of this Assessment using a combination of reviewing existing information sources and field verification of Selected Remnant dimensions. Existing information sources reviewed by Peer included concrete volume calculations developed for the property by Dakota County Environmental Management, and a recent volume estimate prepared by DPRA, Inc. (**DPRA**) in the document entitled: *Scoping and Cost Estimates for Conducting Hazardous Materials Building Survey and Concrete Remnant Assessment*, dated June 30, 2006. Field verification was performed on the 51 Selected Remnants and included measuring the dimensions of visible concrete surfaces at the respective locations, and excavating test trenches adjacent to the Selected Remnants to determine the foundation and footing depths. Building numbers/names and GPS coordinates for the Selected Remnants are summarized in **Table 1**.

Test trenches were completed adjacent to each Selected Remnant to confirm the depth of the foundation or footing at that location, and to assess environmental conditions of associated soils. The trenches were excavated parallel to the footing or foundation wall, and when L-shaped trenches were performed, the other side was excavated perpendicular to the footing or foundation wall. The trenches were generally excavated to expose the base of the footing or foundation, or as necessary to evaluate subsurface conditions. Test trench logs documenting subsurface observations at each Selected Remnant, including observations of footing and foundation types/depths are included in **Appendices C** through **I**. Additional information related to test trench completion is provided in **Section 3.4**.

3.3 CONCRETE SAMPLING

Concrete sampling activities were conducted by Peer. A combination of coring and hammer drilling was used to collect the concrete samples from the 51 Selected Remnants. Concrete samples were collected from above grade portions of each Selected Remnant. Concrete samples targeted for analysis of volatile organic compounds (**VOCs**) were collected by mechanical coring, using a heavy-duty coring machine with a 3-inch diameter diamond core barrel. The concrete cores were crushed on-site to an appropriate size as specified in the Assessment Work Plan. The other concrete samples were collected using a rotary hammer drill with a one-inch diameter, 4-cutter masonry drill bit. All concrete samples were collected to a minimum penetration depth of six-inches below the surface elevation or the thickness of the Selected Remnant, whichever was less. The concrete samples were submitted for analytical testing as discussed in **Section 3.5**.

In addition to the concrete samples collected for environmental analytical testing, three additional 3-inch diameter by 4-inch long concrete cores were collected and submitted to American Engineering Testing, Inc. (**AET**) for geotechnical testing (i.e. compressive strength). A copy of the geotechnical testing results is included in **Appendix J**. The concrete compressive strength test results ranged from 5,980 pounds per square inch (**psi**) to 9,140 psi. The concrete compressive strengths are typical of concrete floor slab mix designs and indicate that the concrete is structurally competent.

Photographs were taken of each concrete sample location as well as identifying the GPS coordinates. Copies of the photographs are included in **Appendices C** through **I**. Each concrete sample location was assigned an individual sequential identification number (e.g. **CS-1-207-B**).

3.4 TEST TRENCHING AND SOIL SAMPLING

A total of seventy-two (**72**) test trenches (see **Table 1**) were completed adjacent to the 51 Selected Remnants to allow for visual assessment of the depth and construction of foundations/footings, and to evaluate the environmental condition of soils adjacent to and/or in contact with the foundations/footings. Veit completed the test trenches using a track-mounted excavator.

The trenches were generally excavated to expose the base of the footing or foundation (approximately 4 to 12 feet below ground surface - **bgs**), or as necessary to evaluate subsurface conditions. Test pit logs documenting subsurface observations at each Selected Remnant, including observations of footing and foundation types/depths are included in **Appendices C** through **I**.

Excavation occurred in approximate two-foot lifts. The excavated soil was placed adjacent to the test trench in a sequenced fashion to allow for soil assessment and sample collection. If visual and/or olfactory evidence of impacts were noted, the surficial soils were temporarily placed on polyethylene sheeting prior to replacement in the excavation. Upon completion, each test trench was immediately backfilled using the excavator and a skid steer. The test trenches were backfilled in two-foot lifts and bucket compacted. The soil was returned to the test trench in the general order in which it was excavated. The excavation area was graded to match existing conditions and the ground surface was compacted using the excavator.

Soil samples were collected from the test trenches at approximately two-foot intervals to the termination depth of each trench. The soil samples were screened for organic vapors using a photoionization detector (**PID**) with an 11.8 eV lamp. Soil samples were collected from the test trenches for classification purposes and analytical testing as summarized in **Section 3.5**. All soil samples obtained from the trenches were evaluated for evidence of debris and contamination in the field using visual and odor criteria.

Photographs were taken and GPS coordinates were recorded at each test trench location. Copies of the photographs are included in **Appendices C** through **I**. Each test trench was assigned a sequential individual number (e.g. **TT-1-207-B**).

3.5 ANALYTICAL TESTING

Concrete and soil samples collected as part of this Assessment were submitted for analytical testing to Minnesota Valley Testing Laboratory, Inc. (**MVTL**), MDH Certification #027-015-125. MVTL conducted all of the analyses with the exception of explosives, asbestos and chromium VI. Keystone Laboratories, Inc. of Newton, Iowa ran the explosive analyses; Anatek Labs, Inc. of Moscow, Idaho and Spokane, Washington ran the asbestos analyses; and TestAmerica of Cedar Falls, Iowa which ran the chromium VI (**hexavalent chromium**) analyses. Analytical testing parameters for the concrete and soil samples were pre-selected based on historical GOW uses and related operational processes associated with Selected Remnants. Copies of analytical testing reports and sample chain-of-custody forms are in **Appendix K**. The following is a summary listing of the total number of concrete and soil samples submitted and the associated analytical testing parameters:

ANALYTICAL TESTING SUMMARY	
Analyte	**No. of Samples**
Concrete Samples	
PCBs (EPA Method 8082)	26
RCRA Metals (EPA Methods 6010 and 7471)	62
SVOCs-Base Neutral Extractables (EPA Method 8270)	51
Asbestos EPA Method 600/R-19/116)	79
VOCs (EPA Method 8021)	21
VOCs/Alcohols ("**alcohols**") (EPA Method 8015B)	10
DPA/Aniline (EPA Method 8270)	19
Explosives (EPA Method 8330)	28
TCLP Metals (lead)	1
Hexavalent Chromium (EPA Method SW7196)	9
Soil Samples	
PCBs (EPA Method 8082)	21
RCRA Metals (EPA Methods 6010 and 7471)	110
SVOCs- Base Neutral Extractables (EPA Method 8270)	56
Asbestos EPA Method 600/R-19/116)	77
VOCs (EPA Method 8021)	26
VOCs/Alcohols ("**alcohols**") (EPA Method 8015B)	11
DPA/Aniline (EPA Method 8270)	34
Explosives (EPA Method 8330)	40
TCLP Metals (mercury and lead)	1 - Mercury/9 - Lead
Hexavalent Chromium (EPA Method SW7196)	7

Selected concrete and soil samples were analyzed for alcohol compounds, including isopropyl alcohol, methanol, ethanol, methyl ethyl ketone, methyl isobutyl ketone, acetone, n-nitroso-di-n-butylamine and 2-picoline. Three of the eight alcohol compounds (isopropyl alcohol, methanol, and ethanol) were quantified using EPA Method 8015B. The remaining five alcohol compounds were quantified using EPA Methods 8021 and 8270, which provide lower detection limits than EPA Method 8015B.

4.0 RESULTS

4.1 GENERAL

The following parts of this section present the results of the concrete volume estimates, concrete sampling and test trenching and soil sampling. The concrete sampling and test trenching/soil sampling results are defined and discussed by Operational Area. Related data including sampling locations maps, operational area schematic maps, analytical summary tables, project photographs, test trench logs, historical photographs are presented in **Appendices C** through **I**. Copies of historical building plans are included on the computer disk ("**CD**") in **Appendix K** of this report.

4.2 CONCRETE VOLUME ESTIMATES

Based on review of the historical building plans (see **Appendix K**) and visual assessment by Peer during the site reconnaissance and test trenching activities, the following general observations were made in relation to the footing types and depths associated with the Selected Remnants. Photographs of the foundation/footing construction for the Selected Remnants from each area are included in **Appendices C** through **I**.

Three types of foundation/footings were observed during test trenching activities and historical plan review. The vast majority of the foundations/footings consisted of a poured concrete foundation wall supported by concrete columns or piers on concrete footing pads (see **Project Photographs in Appendix D - Building 112B**; **Appendix E - Building 269B**), rather than conventional spread footings. Several poured concrete foundation walls supported by spread footings were also observed. In a few cases the poured concrete foundation wall, column or pier did not have a spread footing or pad (e.g. see **Project Photographs in Appendix D - Building 401A-3**).

All footings, column and piers, if present, were constructed of poured concrete. The majority of the foundation walls were constructed of poured concrete. Foundation walls constructed of concrete block were observed in seven (**7**) of the 51 Selected Remnants.

Top of footing depths ranged from two (**2**) to ten (**10**) feet bgs. The average top of footing depth was four (**4**) feet bgs with a footing thickness of twelve (**12**) inches. This is typical construction in cold weather climates. Deeper below grade top of footing depths (i.e. 6-12 feet) were observed in building areas where sumps or pits were present. The top of footing depths are included in the test trench logs included in **Appendices C** through **I**.

The footing and foundation types and depths observed in the test trenches, combined with the field verified dimensions, were used to estimate the volume of concrete associated with each Selected Remnant as presented in **Table 2**. In summary, the total volume of concrete for the 51 Selected Remnants is estimated at 322,056 cubic feet (**ft^3**), or approximately 11,928 cubic yards (**yd^3**).

The concrete volume estimates for the Selected Remnants were used by Peer to update the previous comprehensive concrete volume estimate tables prepared for the Property by DRPA and Dakota County in June 2006. **Table L-1** in **Appendix L** was prepared by Peer and provides the estimated concrete volume for all types of GOW remnants that were the same as the Selected Remnants evaluated by this Assessment. The table was generated by taking the estimated concrete volume for each Selected Remnant, and then multiplying that volume by the total number of a given type of remnant. **Tables L-2a** through **L-2d** in **Appendix L** were modified by Peer from the 6/06 DPRA/Dakota County tables to include a total concrete volume estimate for all GOW remnants/structures at the Property (excluding those listed and accounted for in **Table L-1**). Field verification of the data presented in **Tables L-2a** through **L-2d** was not conducted by Peer as part of this Assessment. **Table L-3** in **Appendix L** (prepared by DPRA and Dakota County) includes a listing of previously determined GPS coordinates for all GOW remnants/structures on the Property.

The updated volumes of concrete remnants/structures in yd^3 present at the Property as calculated by Peer based on the currently available information are as follows:

GOW Remnant/Structure	6/06 - DPRA/Dakota County Estimated Volume (yd^3)(1)	10/06 - Peer Engineering Estimated Volume (yd^3)(2)
Footings	39,667	24,076
First Floors	51,748	31,593
Second Floors	10,109(3)	8,932(3)
Remnants	69,203	67,002
Estimated Totals	170,727(4)	131,603(4)

Notes:
(1)See **Tables L-2a** through **L-2d** in **Appendix L** for additional detail.
(2)See **Tables L-1** in **Appendix L** for additional detail.
(3)The estimated concrete volume for 2nd floors is based on previous non-field verified information provided by Dakota County. Peer believes the estimated volume is overstated given that Peer's reconnaissance did not identify any second floors on the Selected Remnants evaluated.
(4) This estimate does not include the concrete volume associated with GOW buildings demolished and disposed at various locations on the Property, or concrete roadways remaining from the GOW era.

In summary, Peer calculated an approximate total concrete volume related to concrete remnants and structures on the Property of 131,603 yd^3. For comparison purposes, the previous concrete volume estimate for the entire Property prepared by DPRA (as modified from an earlier Dakota County estimate) was approximately 170,727 yd^3, which is approximately 23% higher than Peer's estimate. Historical construction information indicates the total volume of concrete to be used for construction of the GOW facility was 162,000 yd^3.

The following observations are provided regarding the updated concrete volume estimate as compared to the 6/06 DPRA/Dakota County estimate and historical GOW construction estimate:

- 6/06 DPRA/Dakota County estimate was based on limited field measurements and assumed depths and thicknesses for building footings, while Peer's updated estimate was based on actual field measurements.

- Peer noted that as-building construction of some structures was different than shown on the historical building plans.

- Above-grade portions of various remnants/structures have been removed.

- The GOW construction estimate lists one line item regarding concrete labeled: "Concrete (Estimate Total of All Types Required): 162,000 cu. yds.". This estimate provides no breakdown as to per area or structure type. In addition, it is not clear whether this was a pre-construction engineer's estimate or an as-built estimate.

Section 5.0 presents a summary of the Selected Remnants where asbestos or other hazardous substances were identified in the concrete and/or soil, and provides a discussion of mitigation strategies to address the asbestos and/or hazardous substance impacts to allow for excavation, demolition and reuse of the concrete materials.

4.3 CONCRETE SAMPLING

4.3.1 General

The following sections discuss the results of analytical testing conducted on the concrete samples by operational area. Analytical summary tables and supporting historical information are included for each of the operational areas in **Appendices C** through **I**. It should be noted that concrete samples collected from Building 105B were inadvertently labeled as being from Building "106B" (CS-6-1-106B and CS-6-2-106B).

The analytical testing results identified following common issues:

- Total chromium was identified in all six-two (**62**) concrete samples analyzed at concentrations ranging from 8.2 mg/kg to 42.4 mg/kg. Because the total chromium analysis (**EPA Method 6010**) used did not differentiate between chromium III and hexavalent chromium (i.e. chromium VI), direct comparison of the results could not be made to the MPCA SRVs and SLVs, which are established for chromium III and chromium VI. Therefore nine (**9**) of the samples from various operational areas which generally had the highest total chromium concentrations were reanalyzed for hexavalent chromium. The results indicated that hexavalent chromium was not detected above the laboratory reporting limits in any of the concrete samples, indicating the total chromium concentrations detected are attributable to chromium III. All detected total chromium concentrations were below the Residential SRV of 44,000 mg/kg and the SLV of 1,000,000 mg/kg for chromium III.

- The SVOC isophorone, which is a solvent compound derived from acetone, was identified at concentrations ranging from 3.8 mg/kg to 34.4 mg/kg in forty-seven (**47**) of the fifty-one (**51**) concrete samples analyzed by EPA Method 8270. However, isophorone was not detected in any of the soil samples collected from the test trenches completed adjacent to the Selected Remnants. Review of available public information, historical property information, and concrete sampling procedures revealed no clear source for the isophorone. MVTL reviewed the initial analytical results and internal laboratory quality control data, and then reanalyzed selected samples to determine if the isophorone had be created through the sample preparation procedure they were using (i.e. EPA Method 3545). EPA Method 3545 includes solvent extraction of the samples using acetone and methylene chloride, under pressure and heat. MVTL determined that the isophorone was not in the original sample matrix. Rather the concentrations of isophorone detected in the concrete samples were created by the sample extraction process; thus, MVTL footnoted all of the analytical testing reports accordingly. MVTL issued a letter to Peer dated October 11, 2006 which further discusses this issue (see **Appendix J**).

- Asbestos samples collected during concrete sampling included both samples of the concrete remnant and "bulk" samples of suspect building materials associated with the remnants (e.g. red and black mastic present on floor surfaces, wallboard fragments). No asbestos was detected in samples of any of the concrete remnant samples. Asbestos was detected in sample CS-53-224A, however it is believed that the detected asbestos was related to cross-contamination. Eight (**8**) of ten (**10**) "bulk" samples of the mastic materials had asbestos concentrations of 1% or greater (see **Table 3**). Two of three wallboard samples (CS-29-2-208C and CS-48-3-214C) tested positive for asbestos. The wallboard material fragments were not adhered to the concrete remnants.

4.3.2 East Acid Area and Oleum Plant

The following building remnants were evaluated in the East Acid Area and Oleum Plant:

302-A-1; Acid Area Tank Farm NA Storage Tanks
303A, S.A; Sulphuric Acid Concentrator
305A1; Acid Area Tank Farm Concentrated Mix Circulators
1501-5; Oleum Plant - Sulfur Storage
303A-2; Nitric Acid Concentrator
722Y; Area Shop

A total of six (**6**) concrete samples were collected and analyzed from this area. The concrete analytical data and historical information for each remnant evaluated is included in **Appendix C**.

The following observations are provided regarding the concrete analytical testing results:

- No VOCs were detected in the samples analyzed.
- No samples from this area were analyzed for alcohols.
- Benzyl butyl phthalate (**BBP**) and bis(2-ethylhexyl)phthalate were the only BNEs detected in the samples. The concentrations of BBP, DBP and bis(2-ethylhexyl)phthalate detected were below the respective Residential SRVs and SLVs.
- No PCBs were detected in the samples analyzed.
- No samples from this area were analyzed for explosive compounds
- Aniline and DPA were not detected in the samples analyzed.
- Metals concentrations detected were below the Residential SRVs and SLVs.
- No asbestos was detected in the samples analyzed.

4.3.3 East Guncotton/Nitrocellulose Production Area

The following building remnants were evaluated in the East Guncotton/Nitrocellulose Production Area:

- 101B; Pre-Treated Purified Cotton Storehouse
- 102-B2; Acid Tanks on Saddles
- 104B; Cotton Dry House
- 105B; Nitrating House
- 106B; Spent Acid Filters
- 108B; Boiling Tub House
- 109B; Pulping House
- 111B; Nitrocellulose Slurry Tank Re-Slurry
- 112B; Poacher Tub House
- 113B; Blending Tub & Final Wringer House
- 120B-1; Save All Pit
- 201B; Nitrocellulose Lag Storehouse
- 501B (501-B1); Transformer Substation
- 707-F; Cotton Drying Laboratory (Purification Change House)
- 722B; Area Shop

A total of thirty (**30**) concrete samples were collected and analyzed from this area. The concrete analytical data and historical information for each remnant evaluated is included in **Appendix D**.

The following observations are provided regarding the concrete analytical testing results:

- No samples from this area were analyzed for VOCs or alcohols.
- Di-n-butyl phthalate (**DBP**) and various BNEs were detected in the samples analyzed. The individual BNE concentrations were below Residential SRVs or SLVs, if established. The benzo(a)pyrene (**BaP**) equivalent concentrations were below the Residential SRV of 2 mg/kg and SLV of 10.2 mg/kg.
- No PCBs were detected in the samples analyzed.
- Explosive compounds were not detected in the samples analyzed; aniline and DPA were also not detected.
- Metals concentrations detected were below the Residential SRVs and SLVs.
- Asbestos was detected in one sample of black mastic which was obtained from the concrete surface of Remnant 106B (CS-7-1-106B).

4.3.4 East Solvent Area

The following building remnants were evaluated in the East Solvent Area:

- 207B; Ether and Alcohol Rectifying House
- 207-AC1; Caustic Mix House
- 209A; Scrap Re-Work House
- 226A; Hydraulic & Refrigerator House
- 202C; Dehydration Press House alcohol added
- 263A; DNT Transfer Platform and Ramp
- 205A; DNT Screening House
- 206B; Ether Mix House
- 208C; Mixer House Macerator & Blocking
- 234H; Vertical Press Houses
- 251B; Activated Carbon Solvent Recovery
- 214C-13; Solvent Recovery Houses
- 233A; Screen Cleaning House
- 269B; Water Dry House

A total of thirty-three (**33**) concrete samples were collected and analyzed from this area. The concrete analytical data and historical information for each remnant evaluated is included in **Appendix E**.

The following observations are provided regarding the concrete analytical testing results:

- No VOCs were detected in the samples.
- Isopropyl alcohol and methanol were detected in nine (**9**) of the samples. Isopropyl alcohol concentrations ranged from 100 mg/kg to 300 mg/kg (with a laboratory reporting limit of 100 mg/kg); there are no SRVs or and SLVs established for isopropyl alcohol. Methanol concentrations ranged from 100 mg/kg to 600 mg/kg; which is below the Residential SRV of 9,100 mg/kg; there is no SLV established for methanol.
- BNEs were detected in all fourteen (**14**) samples analyzed. The individual BNE and BaP equivalent concentrations were below the Residential SRVs and SLVs.
- PCBs were detected in one sample (SS-205A) at a concentration of 0.0307 mg/kg, which is below the Residential SRV of 1.2 mg/kg and SLV of 2.1 mg/kg.
- 2,4-DNT was detected in two samples (CS-30-208C and CS-63-269B) at concentrations of 0.248 mg/kg and 0.113 mg/kg, respectively. These concentrations are below the Residential SRV of 50 mg/kg, but exceed the SLV of 0.001 mg/kg. DPA was detected in one of the sixteen samples (CS-31-206B) at a concentration of 0.152 mg/kg. Currently, there is no Residential SRV for DPA. The DPA concentration was below the SLV of 1.6 mg/kg.
- Metals concentrations detected were below the Residential SRVs and SLVs.
- Sample CS-36-2-233A had a total lead concentration of 30.8 mg/kg which is below the Residential SRV of 300 mg/kg; TCLP lead concentration of this sample was < 0.5 mg/l which is below the hazardous was criterion of 5 milligrams per liter (**mg/l**).
- Asbestos was detected in four of the samples analyzed, including CS-29-2-208C - white wallboard, CS-36-1-233A - black mastic, CS-37-1-209A - red mastic, and CS-48-3-214C-13 - white wallboard.

4.3.5 East Powder Manufacturing Area

The following building remnants were evaluated in the East Powder Manufacturing Area:

- 220C; Controlled Circulation Dry House
- 222A; Blend Tower and Pack House (Starter and Heater Houses)
- 235A; Rifle Powder Water Dry House
- 236B; Sweetie Barrel House
- 237-F; Tray Dryers and Fan House
- 238B; Glaze Barrel House
- 239A; Shaker Sieve Houses
- 240-C; Powder Blend Tower and Pack House

A total of fourteen (**14**) concrete samples were collected and analyzed from this area. The concrete analytical data and historical information for each remnant evaluated is included in **Appendix F**.

The following observations are provided regarding the concrete analytical testing results:

- No samples from this area were analyzed for VOCs or alcohols.
- DBP and bis(2-ethylhexyl)phthalate were the only BNEs detected in the samples. The concentrations of DBP and bis(2-ethylhexyl)phthalate were below the respective Residential SRVs and SLVs.
- No PCBs were detected in the samples analyzed.
- Explosive compounds were not detected in the samples analyzed; aniline and DPA were also not detected.
- Metals concentrations detected were below the Residential SRVs and SLVs.
- Asbestos was detected in three samples of mastic material; CS-55-2-239A, CS-56-2-238B, and CS-62-2-236B.

4.3.6 East Powder Testing Area

The following building remnants were evaluated in the East Powder Testing Area:

- 224A; Air Test House
- 228-A; Ballistic Lab and Range

A total of three (3) concrete samples were collected and analyzed from this area. The concrete analytical data and historical information for each remnant evaluated is included in **Appendix G**.

The following observations are provided regarding the concrete analytical testing results:

- No samples from this area were analyzed for VOCs, alcohols or PCBs.
- No BNEs were detected in the concrete samples analyzed.
- Explosive compounds were not detected in the samples analyzed; aniline and DPA were also not detected.
- Metals concentrations detected were below the Residential SRVs and SLVs.
- Asbestos was detected in one concrete sample (CS-53-224A), but was likely due to some type of cross-contamination.

4.3.7 Power Plant "A" Area

The following building remnants were evaluated in the Power Plant "A" Area:

- 401-A1; Power House Smokestack
- 401A; Power House

A total of six (**6**) concrete samples were collected and analyzed from this area. The concrete analytical data and historical information for each remnant evaluated is included in **Appendix H**.

The following observations are provided regarding the concrete analytical testing results:

- No VOCs were detected in the samples analyzed.
- DBP was the only BNE detected in the samples. The DBP concentrations were below the Residential SRV of 2,440 mg/kg and the SLV of 23 mg/kg.
- No PCBs, aniline or DPA were detected in the samples.
- No samples from this area were analyzed for explosives.
- Metals concentrations detected were below the Residential SRVs and SLVs.
- No asbestos was detected in the concrete samples analyzed.

4.3.8 Main Shop Area

The following building remnants were evaluated in the Main Shop Area:

- 716A; Garage and Repair Shop
- 716B; Car Wash and Grease Shop
- 726-A1; Unspecified Storage
- 726A; Acetylene Storage

A total of four (**4**) concrete samples were collected and analyzed from this area. The concrete analytical data and historical information for each remnant evaluated is included in **Appendix I**.

The following observations are provided regarding the concrete analytical testing results:

- Concrete samples were only collected and analyzed from buildings 716A and 716B; no concrete samples were collected from buildings 726-A1 and 726A, because the surface portions of the building are no longer present.
- The only VOC identified in the samples analyzed was 1,2,4-trimethylbenzene, which was detected in one sample at a concentration below the Residential SRV of 8 mg/kg. There is no SLV established for 1,2,4-trimethylbenzene.

- BNE concentrations detected were below established Residential SRVs and SLVs.
- PCBs were detected in all three samples at concentrations of 0.173, mg/kg, 0.298 mg/kg, and 5.17 mg/kg. The Residential SRV and Industrial SRVs for PCBs are 1.2 mg/kg and 8 mg/kg; the SLV is 2.1 mg/kg.
- No samples from this area were analyzed for explosives.
- Aniline and DPA were not detected in the samples.
- Metals concentrations detected were below the Residential SRVs and SLVs.
- No asbestos was detected in the samples analyzed.

4.4 TEST TRENCHING AND SOIL SAMPLING

4.4.1 General

The following sections discuss the results of analytical testing conducted on the soil samples by operational area. Analytical summary tables and supporting historical information are included for each of the operational areas in **Appendices C** through **I**.

The analytical testing results identified following common issue:

- Total chromium was identified in all one hundred-ten (**110**) soil samples analyzed at concentrations ranging from 4.05 mg/kg to 73.9 mg/kg. Because the total chromium analysis (**EPA Method 6010**) used did not differentiate between chromium III and hexavalent chromium (i.e. chromium VI), direct comparison of the results could not be made to the MPCA SRVs and SLVs, which are established for chromium III and chromium VI. Therefore seven (**7**) of the samples from various operational areas which generally had the highest total chromium concentrations were reanalyzed for hexavalent chromium. The results indicated that hexavalent chromium was not detected above the laboratory reporting limits in any of the soil samples, indicating the total chromium concentrations detected are attributable to chromium III. All detected total chromium concentrations were below the Residential SRV of 44,000 mg/kg and the SLV of 1,000,000 mg/kg for chromium III.

- Asbestos samples collected during test trenching included both "soil" samples and "bulk" samples of visible building material debris (i.e. corrugated roofing material and wallboard which were identified on the historical building plans as asbestos). Asbestos was not detected in any of the soil samples, except TT-3 (0-1')-104B and TT-13(4')-104B. TT-3 (0-1')-104B a sample of surficial soil which contained less than 1% asbestos. TT-13(4')-120B-1 was sediment associated with a sewer pipe encountered at a depth of 4 feet. In general "bulk" samples of building material debris tested positive for asbestos (see **Table 3**).

4.4.2 East Acid Area and Oleum Plant

The building remnants evaluated in the East Acid Area and Oleum Plant are described in **Section 4.3.1** and the associated analytical and historical data are presented in **Appendix C**. A total of seven (**7**) test trenches (**TT-50 through TT-56**) were completed and twelve (**12**) soil samples were collected and analyzed from this area.

The following observations are provided regarding the soil analytical testing results:

- No samples from this area were analyzed for VOCs or alcohols.
- Polynuclear aromatic hydrocarbons (**PAHs**) were detected in six (**6**) samples and DBP in two (**2**) samples by the BNE analysis; the concentrations were below established Residential SRVs and SLVs, with the exception of the BaP equivalent. The concentration of BaP equivalent in sample TT-56(0-1')-303A exceeded the Residential SRV of 2 mg/kg, the Industrial SRV of 3 mg/kg and SLV of 10.2 mg/kg.
- PCBs were detected in sample TT-54(0-1')-722Y at a concentration of 0.258 mg/kg, which is below the Residential SRV of 1.2 mg/kg.
- No samples from this area were analyzed for explosives; aniline and DPA were not detected in the samples analyzed.
- Metals concentrations were below Residential SRVs and SLVs, with the exception of cadmium, lead and mercury. One (**1**) sample had a cadmium concentration (47.6 mg/kg) which exceeded the SLV of 4.4 mg/kg and the Residential SRV of 25 mg/kg, but was less than the Industrial SRV of 200 mg/kg. Total lead was detected in one sample [TT-56(4')-303A] at concentration of 8,090 mg/kg, which exceeded the Residential SRV of 300 mg/kg, the Industrial SRV of 700 mg/kg and SLV of 525 mg/kg. TCLP lead concentration in this sample was 512 mg/l, which exceeds the hazardous waste criterion on 5 mg/l. One (**1**) sample had a mercury concentration (1.2 mg/kg), which exceeded the Residential SRV of 0.5 mg/kg.
- Asbestos was not detected in any of the samples analyzed.

4.4.3 East Guncotton/Nitrocellulose Production Area

The building remnants evaluated in the East Guncotton/Nitrocellulose Production Area are described in **Section 4.3.2** and the associated analytical and historical data are presented in **Appendix D**. A total of twenty (**20**) test trenches (**TT-1 through TT-20**) were completed and 38 soil samples were collected and analyzed from this area.

The following observations are provided regarding the soil analytical testing results:

- VOCs were not detected in the samples analyzed.
- No samples from this area were analyzed for alcohols.
- BNEs (primarily PAHs) were detected in six (**6**) samples. PAH concentrations were below established Residential SRVs and SLVs in five of the samples; however the BaP equivalent in the sixth sample exceeded the Residential SRV of 2 mg/kg, the Industrial SRV of 3 mg/kg and SLV of 10.2 mg/kg.
- PCBs were not detected in the samples analyzed.
- Explosive compounds were not detected in the samples analyzed; aniline and DPA were also not detected.
- Metals concentrations detected were below the Residential SRVs and SLVs, with the exception of arsenic and lead. The arsenic concentration in one sample exceeded the Residential SRV of 5 mg/kg. The lead concentration in three of the 38 samples ranged from 308 mg/kg to 1,710 mg/kg and exceeded the Residential SRV. The two samples with the highest total lead concentrations were analyzed for TCLP lead. The TCLP lead concentrations both samples [TT-9(0-3")-108B and TT-12(6')-501B] were < 0.5 mg/l, which is below the hazardous waste criterion of 5 mg/l.
- Asbestos was detected in two samples; the surficial soil sample TT-3 (0-1')-104B, which had a concentration of less than< 1%, and the sediment sample TT-13 (4')-120B-1, which had a concentration of 2%.

4.4.4 East Solvent Area

The building remnants evaluated in the East Solvent Area are described in **Section 4.3.3** and the associated analytical and historical data are presented in **Appendix E**. A total of twenty-four (**24**) test trenches (**TT-21 through TT-42, TT-46 and TT-47**) were completed and twenty-nine (**29**) soil samples were collected and analyzed from this area.

The following observations are provided regarding the soil analytical testing results:

- The only VOC detected in the samples was acetone. Acetone was detected in TT-40(0-1')-214C-13 at 0.9434 mg/kg, which was below the Residential SRV of 340 mg/kg, but slightly exceeded the SLV of 0.7 mg/kg.
- Methanol was the only alcohol identified; it was detected in one sample [TT-24(0-1')-208C at a concentration of 100 mg/kg (which was the laboratory reporting limit), which is below the Residential SRV of 9,100 mg/kg. There is no SLV established for methanol.

- 2,4-Dinitrotoluene (**2,4-DNT**) and 2,6-dinitrotoluene (**2,6-DNT**) were detected by the BNE analysis in one sample [TT-36(0-1')-209A] at concentrations of 1.802 mg/kg and 0.061 mg/kg, respectively. 2,4-DNT was also detected in this sample by the explosives analysis at a concentration of 0.35 mg/kg. The concentrations of 2,4-DNT were below the Residential SRV of 50 mg/kg, but exceeded the SLV of 0.001 mg/kg.
- DBP and PAHs were also detected in several samples in the BNE analysis. The DBP concentrations were below the SLV of 23 mg/kg. The BaP equivalent concentration in one sample exceeded the Residential SRV of 2 mg/kg, the Industrial SRV of 3 mg/kg, and the SLV of 10.2 mg/kg.
- No PCBs were detected in the samples analyzed.
- Aniline was not detected in the samples; however DPA was detected in two samples at concentrations below the SLV of 1.6 mg/kg. There are no established SRVs for DPA, but EPA lists a Soil Screening Level (SSL) for ingestion of 1,960 mg/kg, which is based on an assumed residential land use.
- Metals concentrations detected were below the Residential SRVs and SLVs, with the exception of chromium.
- Asbestos was detected in four building material samples at concentrations of 35% to 45%, including TT-30-1(Surface)-234H - insulation, TT-30-3(Surface)-234H - tar paper, TT-40(0-1')-214C-13 - loose black mastic, and TT-41(6")-269B - wallboard.

4.4.5 East Powder Manufacturing Area

The building remnants evaluated in the East Powder Manufacturing Area are described in **Section 4.3.4** and the associated analytical and historical data are presented in **Appendix F**. A total of eleven (**11**) test trenches (**TT-43, TT-44, TT-63 through TT-68, TT-70, TT-71 and TT-72**) were completed and thirty-five (**35**) soil samples were collected and analyzed from this area.

The following observations are provided regarding the soil analytical testing results:

- No samples from this area were analyzed for VOCs or alcohols.
- 2,4-DNT was detected by the BNE analysis in four samples at concentrations of 0.214 mg/kg to 3.756 mg/kg. 2,4-DNT was also detected in two samples by the explosives analysis. The concentrations of 2,4-DNT were below the Residential SRV of 50 mg/kg, but exceeded the SLV of 0.001 mg/kg.
- Aniline was not detected in the samples; however DPA was detected in two samples at concentrations of 0.203 mg/kg and 0.236 mg/kg, which are below the SLV of 1.6 mg/kg. There are no established SRVs for DPA, but EPA lists a SSL for ingestion of 1,960 mg/kg, which is based on an assumed residential land use. There are no established SRVs or SLVs for aniline or DPA.
- DBP and PAHs were also detected in several samples in the BNE analysis. The DBP concentrations were below the SLV of 23 mg/kg. The BaP equivalent concentration in two samples exceeded the Residential SRV of 2 mg/kg.

- PCBs were not detected in the one sample analyzed.
- Metals concentrations detected were below the Residential SRVs and SLVs, with the exception of arsenic, lead, selenium and silver. Arsenic was detected in eight (**8**) samples at concentrations ranging from 12.55 to 22.29 mg/kg, all of which exceeded the Residential SRV of 5 mg/kg; one (**1**) sample exceeded the Industrial SRV of 20 mg/kg; three (**3**) samples exceeded the SLV of 15.1 mg/kg. The lead concentration in four of the samples ranged from 332 mg/kg to 547 mg/kg and exceeded the Residential SRV of 300 mg/kg and in one sample the SLV of 525 mg/kg. The three samples with the highest total lead concentrations were analyzed for TCLP lead. The TCLP lead concentrations in these samples [TT-63(0-1')-220C, TT-71-2(SURFACE)-238B TT-71-3(SURFACE)-238B] were < 0.5 mg/l, which is below the hazardous waste criterion on 5 mg/l. Selenium was detected in one of the samples at a concentration of 1.624 mg/kg, which was below the Residential SRV of 160 mg/kg, but exceeded the SLV of 1.5 mg/kg. Silver was detected in six (**6**) of the samples at concentrations ranging from 4.203 mg/kg to 14.18 mg/kg, which exceed the SLV of 3.9 mg/kg, but were below the Residential SRV of 160 mg/kg.
- Asbestos was detected in nine (**9**) of the samples of mastic and building material debris analyzed at concentrations ranging from 1% to 40%.

4.4.6 East Powder Testing Area

The building remnants evaluated in the East Powder Testing Area are described in **Section 4.3.5** and the associated analytical and historical data are presented in **Appendix G**. A total of two (**2**) test trenches (**TT-45 and TT-69**) were completed and four (**4**) soil samples were collected and analyzed from this area.

The following observations are provided regarding the soil analytical testing results:

- No samples from this area were analyzed for VOCs, alcohols or PCBs.
- PAHs and DBP were detected in the BNE analysis in sample TT-45(5')-228C; the concentrations were below established Residential SRVs and SLVs.
- Explosive compounds were not detected in the samples analyzed; aniline and DPA were also not detected.
- Metals concentrations detected were below the Residential SRVs and SLVs.
- No asbestos was detected in the samples analyzed.

4.4.7 Power Plant "A" Area

The building remnants evaluated in the Power Plant "A" Area are described in **Section 4.3.6** and the associated analytical and historical data are presented in **Appendix H**. A total of two (**2**) test trenches (**TT-48 and TT-49**) were completed and five (**5**) soil samples were collected and analyzed from this area.

The following observations are provided regarding the soil analytical testing results:

- No VOCs were detected in the one sample analyzed.
- No samples were analyzed from this area for alcohols.
- PAHs were detected in the BNE analysis in the samples, but at concentrations below established Residential SRVs and SLVs.
- No samples from this area were analyzed for explosives.
- PCBs, Aniline and DPA were not detected in the samples analyzed.
- Metals concentrations detected were below the Residential SRVs and SLVs, with the exception of lead in sample TT-49(0-1')-401A, which was detected at 335 mg/kg. This sample was analyzed for TCLP lead; the TCPL lead concentration was < 0.5 mg/l, which is below the hazardous waste criterion of 5 mg/l.
- No asbestos was detected in the samples analyzed.

4.4.8 Main Shop Area

The building remnants evaluated in the Main Shop Area are described in **Section 4.3.7** and the associated analytical and historical data are presented in **Appendix I**. A total of six (**6**) test trenches (**TT-57 through TT-62**) were completed and eleven (**11**) soil samples were collected and analyzed from this area.

The following observations are provided regarding the soil analytical testing results:

- VOCs were detected in samples TT-61-1(0-6")-716A and TT-61-2(0-6")-716A; the concentrations of four compounds exceeded SLVs.
- No samples were analyzed from this area for alcohols.
- PAHs were detected in one sample; the concentration of benzo(a)pyrene equivalent exceeded the Industrial SRV of 3 mg/kg and SLV of 10.2 mg/kg.
- PCBs were detected in the samples from building 716A at concentrations of 0.71 mg/kg to 273 mg/kg; several results exceeded Residential and Industrial SRVs of 1.2 mg/kg and 8 mg/kg, and the SLV of 2.1 mg/kg. PCBs were also detected in two samples from building 716B; one sample had a concentration below the Residential SRV of 1.2 mg/kg, the other had a concentration slightly above the Residential SRV. Materials requiring disposal with PCB concentrations of 50 mg/kg are considered hazardous waste based on current state regulations.
- No samples from this area were analyzed for explosives; aniline and DPA were not detected in the samples analyzed.

- Metals concentrations were below Residential SRVs and SLVs, with the exception of arsenic, lead and mercury. One sample had an arsenic concentration of 7.21 mg/kg, which exceeded the Residential SRV of 5 mg/kg. Lead was detected in three samples TT-60(1.5')-716B, TT-61-1(0-6")-716A and TT-61-2(0-6")-716A at concentrations of 897 mg/kg, 1,390 mg/kg and 2,470 mg/kg; these concentrations exceeded the Industrial SRV of 700 mg/kg and the SLV of 525 mg/kg. TCLP lead concentrations in these samples were 74.7 mg/l and 5.6 mg/l; both results exceed the hazardous waste criterion on 5 mg/l. Mercury was also detected in TT-60(1.5')-716B at 5.5 mg/kg, which exceeded the Industrial SRV of 1.5 mg/kg and SLV of 1.6 mg/kg. The TCLP mercury concentration for this sample was < 0.01 mg/l, which is below the hazardous waste criterion of 0.2 mg/l.
- No asbestos was detected in the samples analyzed.

5.0 CONCLUSIONS

Based on the concrete and soil sampling conducted as part of this Assessment, Peer estimates that approximately 70% of the concrete remnants/structures at the Property are suitable for reuse without mitigation. Peer's professional opinion is that the most economically feasible and cost effective disposition option for the concrete not requiring mitigation is on-site crushing and reuse for road base and/or fill material. Testing of representative concrete samples indicates that the remnant material is suitable for that purpose.

Mitigation will be required for the remainder of the remnants/structures where the concrete is impacted or potentially impacted with asbestos and/or other hazardous materials, to allow reuse of that material. Once specific remnants have been identified for demolition/removal, additional concrete and soil testing will be required to ensure proper management and disposition of any impacted concrete materials and adjacent soils encountered during the project.

The following conclusions are provided regarding the concrete volume estimates, concrete and soil analytical testing results, potential mitigation strategies and concrete reuse options. **Section 6.0** of this Assessment presents recommendations related to mitigation, disposition and reuse of the concrete and general considerations for demolition/removal of the remnants/structures at the Property.

Concrete Volume Estimates

Peer used the data generated from field observations and historical building plans to calculate the volume of concrete associated with walls and foundations (and roofs if present) for the fifty-one (**51**) Selected Remnants evaluated as part of this Assessment. Peer estimates that the volume of concrete associated with these Selected Remnants is approximately 11,928 yd^3. This volume estimate was used to generate the concrete volume associated with other GOW remnants/structures with the same construction as the Selected Remnants. Peer also updated the previous volume calculations made by Dakota County and DPRA for all GOW remnants/structures at the Property. Based on this analysis, Peer estimates that the total volume of concrete associated with all GOW remnants/structures at the Property is approximately 131,603 yd^3. This figure does not include the concrete volume associated with GOW buildings demolished and disposed at various locations on the Property, or concrete roadways remaining from the GOW era.

Concrete Impacts

Asbestos - No asbestos was detected in any concrete material sampled as part of this Assessment, indicated asbestos was not used in the original concrete mix design. Visual observations of the Selected Remnants identified an approximate one-inch thick layer of red or black mastic on the surface of approximately 25% of the concrete floor slabs evaluated by Peer. Mastic was not identified on any of the footings/foundations or walls observed. The floor mastic material appears to be the "spark-proof" coating identified in the historical building plans (see **Appendix K**) that was applied as part of the original GOW construction. Approximately 75% of the red and black mastic samples analyzed contained asbestos at concentrations of 1% or greater (see **Table 3**). The asbestos-containing mastic was identified on buildings: 106B (Spent Acid Filter building), 209A (Pulping House), 233A (Screen Clearing House), 234H (Vertical Press House), 236B (Sweetie Barrel House), 237F (Tray Dryers and Fan House), 238B (Glaze Barrel House), and 239A (Shaker Sieve House). All similar mastic present on buildings constructed for the same or similar use (e.g. Remnants 106A-F, 234A-R, etc.) or other remnants/structures at the Property on which the mastic material is present must be considered to be asbestos-containing.

Building material debris (e.g. mastic, wallboard, transite panels, etc.) was observed on the floor slab and/or adjacent ground surface in approximately 25% (13 out of 51) of the Selected Remnants (see **Table 3**). Sampling and testing of this building material debris confirmed that approximately 85% of the samples contained asbestos at a concentration of 1% or greater.

Other Hazardous Substances - Detectable concentrations of parameters other than asbestos were also identified in the concrete samples collected from various Selected Remnants. These parameters included VOCs, alcohols, BNEs, DPA, PCBs, and metals. These parameters were present at concentrations below the corresponding Residential SRVs and/or SLVs, with the following exceptions: arsenic exceeded the Residential SRV of 5 mg/kg at Building 109B; 2,4-DNT exceeded the SLV of 0.001 mg/kg at Building 208C; and PCBs exceeded the Residential SRV of 1.2 mg/kg and the SLV of 2.1 mg/kg at Building 716A.

Impacts to Adjacent Soils

Asbestos - Asbestos was detected in shallow soil samples collected as part of this Assessment from two test trenches (TT-3 at Remnant 104B and TT-13 at Remnant 120B-1). Asbestos was also detected in samples of building material debris (see **Table 3**) which was present on the floor slabs and/or ground surface adjacent to various remnants as discussed above with respect to the concrete impacts.

Other Hazardous Materials - Detectable concentrations of parameters other than asbestos were identified in the soil samples collected from test trenches constructed adjacent to various Selected Remnants. These parameters included VOCs, alcohols, BNEs, PCBs, explosives (i.e. 2,4-DNT and 2,6-DNT), aniline, DPA, and metals (arsenic, mercury, selenium and silver). These parameters were present at concentrations below their corresponding Residential SLVs and SRVs, with the following exceptions: VOCs exceeded SRVs and/or SLVs at Building 716A, acetone exceeded the SLV at Building 214C-14; BaP equivalent exceeded the Residential SRV and in some instances the Industrial SRV at buildings 303A, 501B, 251B, 235A, 220C and 716B; PCBs exceeded Residential SRV and some instances the Industrial SRV and/or SLV at Buildings 716A and 716B; arsenic exceeded the Residential SRV, and in some instances the Industrial SRV and/or SLV at buildings 111B, 235A, 220C, 222A, 240B, 238B, 237F, 401A and 716A (several locations) and lead (several locations); cadmium, selenium and silver exceeded Residential SRVs and/or SLVs at buildings 303A-2, 220C, 222A, 237F, 238B, 240B, and 716A; lead concentrations exceeded the Residential and Industrial SRVs and in some instances the TCLP hazardous waste criterion of 5 mg/l at buildings 303A, 716A and 716B; lead concentrations also exceeded the Residential and/or Industrial SRVs at buildings 108B, 105B, 113B, 238B, and 401A; mercury exceeded the Residential SRV at Building 302A and Industrial SRV and SLV at Building 716B; 2,4-DNT and/or 2,6-DNT exceeded the SLV of 0.001 mg/kg at buildings 209A, 220C, and 237F.

Mitigation Strategies and Reuse Options

Mitigation Strategies - Prior to demolition/removal of concrete remnants/structures, identified asbestos-containing mastic on concrete surfaces and building material debris (e.g., wallboard, transite panels, etc.) present on the concrete slabs and adjacent ground surface will need to be abated by a licensed contractor. In some cases, it may be more cost effective to remove the concrete with the mastic intact, and dispose of the concrete material at a landfill as asbestos-containing waste. Mitigation (i.e. excavation and disposal) of impacted soils from identified areas may also need to be conducted concurrently with demolition of specific remnants. This is necessary to facilitate the removal of the concrete material and minimize potential cross-contamination of the otherwise clean concrete, which can be targeted for reuse.

Concrete Reuse - Peer evaluated a number of potentially viable reuse options for concrete generated from future demolition/removal of the GOW remnants/structures. Options considered included:

- *Road Base* - Crushed concrete makes an excellent road base material and is usually a cost effective recycling option. Crushing must conform to the desired specifications (e.g. MnDOT Class V, VI or VII). Some amounts of recycled asphalt pavement can be incorporated into the road base. All brick, wood, metal or other debris must be removed.

- *Structural or Special Fill* - Crushed concrete can be beneficially used as structural or special fill (e.g., beneath load-bearing structures, bituminous pavement, etc.). Crushing must conform to desired specifications. Brick and asphalt may remain in the fill material. All other debris must be removed.

- *General fill* - Crushed concrete can be used as general fill which is used for areas not requiring structural support (e.g., green-space areas, embankments, etc.). Crushing must conform to desired specifications. The material is usually crushed to 3-inch minus depending on its use. Brick and asphalt materials may remain. All other debris must be removed.

- *Aggregate in Concrete* - This is a possible option. However, some concrete contains air-entraining agents as well as other additives, which adversely affect strength and chemical aspects of the new concrete.

- *Landfill Disposal* - This option would apply to concrete materials with elevated contaminant concentrations (e.g., adhered asbestos mastic) or impacted soils requiring removal to facilitate demolition. Disposition would depend on contaminant types, concentrations and permitting limitations, and occur at a demolition and/or solid waste landfill.

Based on the results of this Assessment, Peer concludes that for at least 70% of the remnants/structures, removal, crushing and reuse of the concrete as road base and/or structural and general fill is the most economically feasible and cost effective disposition option. For concrete which has asbestos-containing mastic or other hazardous materials impacts (approximately 30% of the total volume), a specific determination must be made as to whether it is more cost effective to 1) abate the asbestos or other hazardous substance, and then reuse the concrete, or 2) remove the concrete as-is (e.g., with the mastic intact), and dispose of the concrete material at an appropriately permitted landfill. A flowchart depicting the disposition options and related decision criteria for the concrete remnants/structures is provided in **Table 4**.

6.0 RECOMMENDATIONS

Based on the results of this Assessment, the following recommendations and other considerations are provided for mitigation, disposal and reuse of GOW concrete remnants/structures at the Property:

Mitigation, Disposition and Reuse of Concrete

- Asbestos testing results for red and black mastic material present on concrete surfaces in some areas were variable; however, asbestos was identified in 75% of the samples tested. Once specific areas and remnant/structures have been identified for removal, additional testing of mastic on each remnant/structure should be conducted to confirm whether mastic present on the concrete is asbestos-containing.

- Hazardous materials surveys of the remnants/structures targeted for demolition should be conducted as required by State regulations in advance of any demolition activities.

- Prior to demolition/removal activities, a Development Response Action Plan/Contingency Plan (DRAP/CP) should be prepared to address, by area, required mitigation actions and related environmental monitoring, sampling and testing requirements.

- Requirements of the DRAP/CP for mitigation, environmental monitoring and reuse requirements should be incorporated into the contract specifications for the concrete remnant/structure demolition/removal and crushing activities.

Considerations for Future Demolition/Removal

- Assemble geographic areas of remnants/structures targeted for demolition/removal bidding purposes based on their type, location and the environmental condition of the concrete (e.g., remnants/structures with or without asbestos or other hazardous substance impacts to concrete or adjacent soils). Assembling larger areas of remnants/structures will ensure adequate volumes of concrete are generated to make processing and reuse of the concrete material economically feasible.

- Provide the selected demolition/removal contractor with adequate, centrally located space on the Property with good accessibility to use for crushing and staging concrete materials prior to transporting for off-site reuse (this is also a necessary requirement to ensure that processing and reuse of the concrete materials is economically feasible).

- Consider retaining some portion of crushed concrete materials generated by demolition/removal of the remnants/structures for use in pending or future University Development projects (retaining a stockpile of this material on-site for reuse as road-base or fill could reduce construction costs for University projects).